MASTER

XXIII

# The effect of polythene and P.V.C. on the temperature of bare soil during late winter and early spring

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Mobile glasshouses may on occasion be moved on to uncropped land during late winter or early spring with the object of starting off a new crop. If it is possible to raise the soil temperature a few degrees before the mobile house is moved, this may lead to a reduction of fuel costs or to earlier germination. One way in which this may perhaps be done is by covering the ground with clear polythene or P.V.C. An investigation has already been made into the radiation transmission of .002" polythene (Morris, 1957-58) [1] which has shown that polythene is highly transparent to radiation up to a wavelength of 15-16$\mu$, except for three narrow absorption bands at $3\frac{1}{2}$, 7 and 14$\mu$. Radiation heat losses from the soil will therefore be practically undiminished by the use of this material. There must, however, be some reduction in convective heat loss beneath a plastic film, compared with the losses from uncovered soil and a series of observations was made to determine whether the increase in soil temperature is sufficient to justify the use of these plastics in this manner.

Small plots of bare soil (4 ft. x 4 ft.) were covered with .005" polythene and .004" P.V.C. Soil thermometers (2", 4" and 8") were inserted through the plastic into the ground and readings for comparison were made in the bare soil plot of the meteorological enclosure, a few yards distant.

Readings were made at 0900 G.M.T. from January 26th to April 3rd, 1959. In general they were made on 5 days a week and the means of these series of five readings have been regarded as weekly means. Readings were also made at 1500 G.M.T., but it was not usually practicable to make observations on 5 days a week and they were generally on 3 or 4 days a week; however, they have been regarded as weekly means in the table of results.

Table I gives the weekly means of temperature at 0900 G.M.T. under bare soil, at depths of 2, 4 and 8 inches; in addition, the amounts by which the weekly means of soil temperature under polythene and P.V.C. exceed that under bare soil are also given. The covering of plastic materials leads to an increase in soil temperature at all depths, and the P.V.C. almost invariably leads to a greater heating effect than the polythene. At this time of year the 2" and 4" temperatures are probably more important horticulturally than the 8", and at these depths thepolythene usually increases soil temperature by 0.5-2.5°F and the P.V.C. by 1-3°F.

Table II gives similar results for the afternoon (1500 G.M.T.). As would be expected, the temperature effects beneath the plastic are greater than at 0900, reaching 6-8°F in a number of weeks at a depth of 2" and 3-6°F at 4". On individual days the 2" soil temperature under the polythene is occasionally 8-10°F above the temperature in uncovered soil, and under the P.V.C. it is sometimes more than 10°F higher than in bare soil. It is clear that these maximum heating effects depend largely on time of sunrise and amount of sunshine.

Curves derived from the values in Tables I and II may be used to give a rough estimate of the advancement of temperature in time under the plastics. At 0900 and at 4" depth it varies from 1 day to about 7 days, with an average of about 4 days. At 1500 G.M.T. the plastics lead to an average advancement of about 7 days. It is therefore reasonable to suggest an average advancement of 5-6 days when the temperature over 24 hours is considered.

## Conclusions

1. At almost all times during the period of observation the soil temperatures under polythene and P.V.C. were higher than those under uncovered soil.

2. The temperatures under P.V.C. were somewhat higher than those under polythene.

3. The temperature differences were considerably greater in the afternoon than in the morning, reaching some 10°F on individual days and often exceeding 5°F in the weekly mean.

4. The advancement of temperature in time under plastics varies with the current weather, but an average of 5 or 6 days has been estimated.

5. This advancement is probably sufficient to be of economic importance for some crops.

Reference Morris, L.G. Sci. Hort. XIII, 1957-58 pp.49-55

Meteorological Office,
National Agricultural Advisory Service,
Bristol.

Agricultural Memorandum No.XXIII

June 1959.

G.1001/BJR/6/59/80

Table I. Weekly means of temperature at 0900 G.M.T. under bare soil and their differences from weekly means under polythene and P.V.C., in °F

| Week No. | Central Date | 2 inches deep | | | 4 inches deep | | | 8 inches deep | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B.S. | P-B.S. | P.V.C.-B.S. | B.S. | P-B.S. | P.V.C.-B.S. | B.S. | P-B.S. | P.V.C.-B.S. |
| 1 | Jan. 28 | 31.6 | 1.5 | 1.8 | 33.1 | 1.2 | 0.9 | 34.7 | 1.4 | 1.4 |
| 2 | Feb. 4 | 32.2 | 0.9 | 1.4 | 33.1 | 1.4 | 1.7 | 34.9 | 1.8 | 2.2 |
| 3 | Feb. 11 | 36.0 | 0.6 | 1.1 | 36.3 | 0.8 | 1.0 | 36.9 | 0.9 | 1.1 |
| 4 | Feb. 18 | 36.0 | 1.4 | 2.2 | 36.9 | 1.5 | 1.8 | 37.9 | 1.7 | 2.4 |
| 5 | Feb. 25 | 43.2 | 0.8 | 1.2 | 42.8 | 0.7 | 1.2 | 42.9 | 0.8 | 1.4 |
| 6 | March 4 | 44.0 | 1.1 | 1.8 | 44.0 | 1.3 | 2.0 | 44.8 | 1.5 | 2.4 |
| 7 | " 11 | 41.8 | 1.8 | 2.7 | 41.3 | 2.0 | 2.7 | 43.0 | 2.0 | 2.9 |
| 8 | " 18 | 37.4 | 3.5 | 4.9 | 38.4 | 3.2 | 4.3 | 40.7 | 3.3 | 4.6 |
| 9 | " 25 | 45.3 | 2.4 | 3.7 | 44.2 | 1.9 | 2.8 | 44.8 | 2.1 | 2.9 |
| 10 | April 1 | 48.9 | 1.8 | 2.5 | 47.4 | 1.8 | 2.9 | 47.3 | 1.6 | 3.0 |

Table II. Weekly means of temperature at 1500 G.M.T. under bare soil and their differences from weekly means under polythene and P.V.C., in °F

| Week No. | Central date | 2 inches deep | | | 4 inches deep | | | 8 inches deep | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B.S. | P-B.S. | P.V.C.-B.S. | B.S. | P-B.S. | P.V.C.-B.S. | B.S. | P-B.S. | P.V.C.-B.S. |
| 1 | Jan. 28 | 35.6 | 3.8 | 4.4 | 35.1 | 2.0 | 2.6 | 35.2 | 1.5 | 1.5 |
| 2 | Feb. 4 | 34.1 | 5.8 | 6.8 | 34.3 | 3.8 | 5.3 | 35.0 | 1.9 | 2.7 |
| 3 | " 11 | 37.8 | 1.1 | 1.6 | 37.1 | 1.0 | 1.2 | 36.7 | 0.8 | 1.3 |
| 4 | " 18 | 44.1 | 2.8 | 3.3 | 41.9 | 1.1 | 1.7 | 39.3 | 1.1 | 1.4 |
| 5 | " 25 | 48.3 | 4.0 | 4.4 | 47.0 | 1.5 | 2.5 | 44.0 | 0.4 | 1.0 |
| 6 | March 4 | 49.4 | 3.8 | 4.0 | 48.2 | 1.8 | 2.6 | 45.8 | 0.8 | 1.8 |
| 7 | " 11 | 51.1 | 6.7 | 7.2 | 49.3 | 3.0 | 4.5 | 45.1 | 1.2 | 2.5 |
| 8 | " 18 | 44.9 | 6.2 | 7.6 | 43.3 | 4.2 | 6.0 | 42.3 | 2.5 | 4.0 |
| 9 | " 25 | 53.0 | 7.1 | 7.5 | 50.6 | 3.3 | 4.6 | 46.9 | 1.0 | 2.2 |
| 10 | April 1 | 54.9 | 5.7 | 6.0 | 52.5 | 2.8 | 4.1 | 48.9 | 1.0 | 2.4 |